

# PATENT ABSTRACTS OF JAPAN

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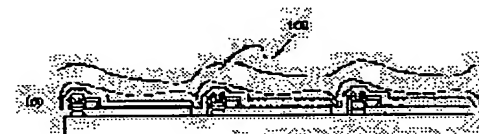
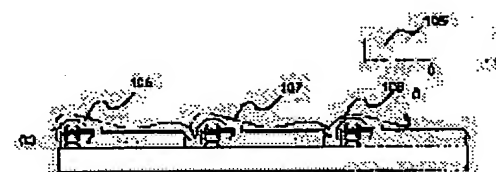
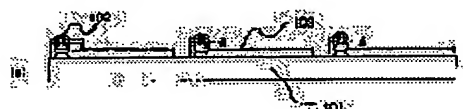
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## (54) MANUFACTURE OF ACTIVE MATRIX TYPE ORGANIC EL DISPLAY BODY

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To manufacture an active matrix type organic EL display body at low cost by pattern-applying organic light emitting materials of red, green and blue on a base having a thin film transistor by means of ink jet.

**SOLUTION:** On a glass base 101, an ITO transparent picture element electrode 103 is formed after a thin film transistor 102 is formed thereon. A positive hole injection layer 104 of polyphenylene vinylene or the like is further formed thereon. This positive hole injection layer 104 is obtained by applying polytetrahydrothiophenyl phenylene of precursor followed by heating and polymerization. Organic light emitting layers 106-108 of red, green and blue are formed thereon every picture element. The organic light emitting layers are color-arranged and formed according to the pattern of each color every picture element by an ink jet printer 105. Further, A reflecting electrode 109 such as Mg, Ag or the like is formed thereon by evaporation.



## LEGAL STATUS

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CLAIMS

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[Claim(s)]

[Claim 1] A hole-injection layer is formed in the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor. In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color besides chosen as the layer from red, green, and blue for every pixel at least is formed, and a reflector is further formed in this upper layer. The manufacture approach of the active-matrix mold organic electroluminescence display object characterized by making formation and the array of said organic luminous layer by the ink jet method.

[Claim 2] The manufacture approach of the active-matrix mold organic-electroluminescence display object characterized by to make formation and the array of said organic luminous layer by the ink-jet method in the manufacture approach of an active-matrix mold organic-electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a reflector is further formed in this upper layer.

[Claim 3] In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, a hole-injection layer is formed in this upper layer, and a transparent electrode is further formed in this upper layer. The manufacture approach of the active-matrix mold organic electroluminescence display object characterized by making formation and the array of said organic luminous layer by the ink jet method.

[Claim 4] The manufacture approach of the active-matrix mold organic-electroluminescence display object characterized by to make formation and the array of said organic luminous layer by the ink-jet method in the manufacture approach of an active-matrix mold organic-electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a transparent electrode is further formed in this upper layer.

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[Translation done.]

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the manufacture approach using the ink jet method of EL display object of the active-matrix mold which used the thin film transistor.

[0002]

[Description of the Prior Art] An organic EL device is a component made to emit light using bleedoff (fluorescence and phosphorescence) of the light at the time of having the configuration whose thin film containing a fluorescence organic compound was pinched in cathode and an anode plate, making an exciton (exciton) generate by making an electron and an electron hole (hole) pour in and recombine with said thin film, and this exciton deactivating.

[0003] The description of this organic EL device is 100 - 100000 cd/m<sup>2</sup> at the low battery not more than 10V. It is that field luminescence of the high brightness of extent is possible, and luminescence from blue to red is possible by choosing the class of fluorescent material.

[0004] The organic EL device attracts attention as what realizes a cheap large area full color display device (an Institute of Electronics, Information and Communication Engineers technical report, the 89th volume, NO.106, 49 pages, 1989). According to the report, the organic coloring matter which emits strong fluorescence was used for the luminous layer, and blue, green, and bright red luminescence have been obtained. this having emitted strong fluorescence by the shape of a thin film, and having used organic coloring matter with few pinhole defects -- it is -- high -- it is thought that the brightness full color display was realizable.

[0005] furthermore, the thin film layer to which the component of an organic luminous layer becomes JP,5-78655,A from the mixture of an organic charge ingredient and an organic luminescent material -- preparing -- concentration quenching -- preventing -- the selection width of face of luminescent material -- extending -- high -- the purport used as a brightness full color component is proposed.

[0006] However, reference is made by neither of the reports about the configuration and the manufacture approach of a actual full color display panel.

[0007]

[Problem(s) to be Solved by the Invention] The organic thin film EL element using the above-mentioned organic coloring matter shows luminescence of blue, green, and red. However, in order to realize a full color display object as known well, it is necessary to arrange the organic luminous layer which emits light in the three primary colors for every pixel. Conventionally, the technique which carries out patterning of the organic luminous layer was made very difficult. A cause is the point that the surface of metal of one of reflector material is unstable, and the patterning precision of vacuum evaporation does not come out. The 2nd is the point that the polymer or precursor which form a hole-injection layer and an organic luminous layer do not have resistance to patterning processes, such as photolithography.

[0008] This invention solves a technical problem which was mentioned above, and the object is in offering the manufacture approach of the active-matrix mold EL display object which carried out patterning of the organic luminous layer for every pixel with the ink jet method.

[0009]

[Means for Solving the Problem] The manufacture approach of the active-matrix mold organic electroluminescence display object in connection with this invention A hole-injection layer is formed in the transperence pixel electrode upper layer formed in the glass substrate which has a thin film transistor. In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color besides chosen as the layer from red, green, and blue for every pixel at least is formed, and a reflector is further formed in this upper layer It is characterized by making formation and the array of said organic luminous layer by the ink jet method. In the transperence pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Moreover, red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, and a reflector is further formed in this upper layer, it is characterized by making formation and the array of said organic luminous layer by the ink jet method.

[0010] In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Furthermore, red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, a hole-injection layer is formed in this upper layer, and a transparent electrode is further formed in this upper layer It is characterized by making formation and the array of said organic luminous layer by the ink jet method. In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Moreover, red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, and a transparent electrode is further formed in this upper layer, it is characterized by making formation and the array of said organic luminous layer by the ink jet method.

[0011] As shown in drawing 3 in short, on the signal line 301 formed on the substrate, the gate line 302, the pixel electrode 303, and a thin film transistor 304, by the ink jet method, this invention is carrying out patterning spreading of red and the organic green and blue luminescent material, and realizes a full color display.

[0012]

[Embodiment of the Invention] Hereafter, the suitable operation gestalt of this invention is explained with reference to a drawing.

[0013] (Example 1) As shown in drawing 1 , after forming a thin film transistor 102 on a glass substrate 101, the ITO transperence pixel electrode 103 is formed.

[0014] The polytetrahydro thiophenyl phenylene which is a polymer precursor as a hole-injection ingredient is coated. By heating, a precursor serves as polyphenylene vinylene and the hole-injection layer 104 with a thickness of 0.05 microns is formed.

[0015] Next, patterning spreading of the luminescent material which colors red, green, and blue with the ink jet printing equipment 105 is carried out, and the coloring layers 106, 107, and 108 with a thickness of 0.05 microns are formed. Polyphenylene vinylene is used for cyano polyphenylene vinylene and green luminescent material, and polyphenylene vinylene and the poly alkyl phenylene are used for blue luminescent material at red luminescent material. It is the Cambridge Display Technologies make, and these organic electroluminescence ingredients are liquefied and available.

[0016] Finally, the MgAg reflector 109 with a thickness of 0.1-0.2 microns is formed with vacuum deposition.

[0017] Thereby, the full color organic electroluminescence display object of a direct viewing type is completed.

[0018] (Example 2) As shown in drawing 2 , after forming a thin film transistor 202 on a glass substrate 201, the ALi reflective pixel electrode 203 is formed.

[0019] Next, patterning spreading of the luminescent material which colors red, green, and blue with the ink jet printing equipment 207 is carried out, and the coloring layers 204, 205, and 206 are formed.

Polyphenylene vinylene is used for cyano polyphenylene vinylene and green luminescent material, and polyphenylene vinylene and the poly alkyl phenylene are used for blue luminescent material at red luminescent material. It is the Cambridge Display Technologies make, and these organic electroluminescence ingredients are liquefied and available.

[0020] The polytetrahydro thiophenyl phenylene which is a polymer precursor as a hole-injection ingredient is formed by the cast method. By heating, a precursor serves as polyphenylene vinylene and the hole-injection layer 208 is formed.

[0021] Finally, the ITO transparent electrode 209 is formed with vacuum deposition.

[0022] Thereby, the full color organic electroluminescence display object of a reflective mold is completed.

[0023] (Example 3) as an organic luminescent material of an organic luminous layer -- 2, 3, 6, 7-tetrahydro-11-oxo--1H, and 5H and 11H -- it considers as a green luminescent material by mixing both using a -(1) benzo PIRANO [6, 7, 8-ij]-kino lysine-10-carboxylic acid, using a 1 and 1-screw-(4-N and N-ditolylamino phenyl) cyclohexane as an organic hole-injection layer ingredient.

[0024] Similarly, they are 2-13' and 4'-dihydroxy phenyl as an organic red luminescent material. - It mixes with a hole-injection layer ingredient using 3, 5, and 7-trihydroxy-1-benzo pyrylium perchlorate.

[0025] Furthermore, tris (8-hydroxy quinolinol) aluminum is used for a blue luminous layer as an organic hole-injection ingredient, and it is 2, 3, 6, and 7-tetrahydro-9-methyl-11-oxo-as an organic luminescent material. - A 1H, 5H, and 11H-(1) benzo PIRANO [6, 7, 8-ij]-kino lysine is mixed, and luminescent material is created.

[0026] At the same process as an example 1 or an example 2, partial patterning of each luminous layer is carried out with ink jet printer equipment, and an active-matrix mold organic electroluminescence display object is created.

[0027] Besides the organic electroluminescence ingredient used by this example, in addition, an aroma tick diamine derivative (TDP), An oxy-diazole dimer (OXD), an oxy-diazole derivative (PBD), A JISUCHIRU arylene derivative (DSA), a quinolinol system metal complex, a beryllium-benzo quinolinol complex (Bebq), A triphenylamine derivative (MTDATA), a JISUCHIRIRU derivative, a pyrazoline dimer, Although rubrene, Quinacridone, a triazole derivative, polyphenylene, the poly alkyl fluorene, the poly alkyl thiophene, an azomethine zinc complex, the Pori Phi Lynne zinc complex, a benzo oxazole zinc complex, and a phenanthroline europium complex can be used It is not the object restricted to this.

[0028]

[Effect of the Invention] Patterning became possible in forming and arranging the organic electroluminescence ingredient it was presupposed that patterning was impossible of an ingredient conventionally with an ink jet method, and the active-matrix mold organic electroluminescence display object of a full color display was realized. Manufacture of the full color display object of a big screen is attained [ that it is cheap and ] by this, and effectiveness is size.

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[Translation done.]

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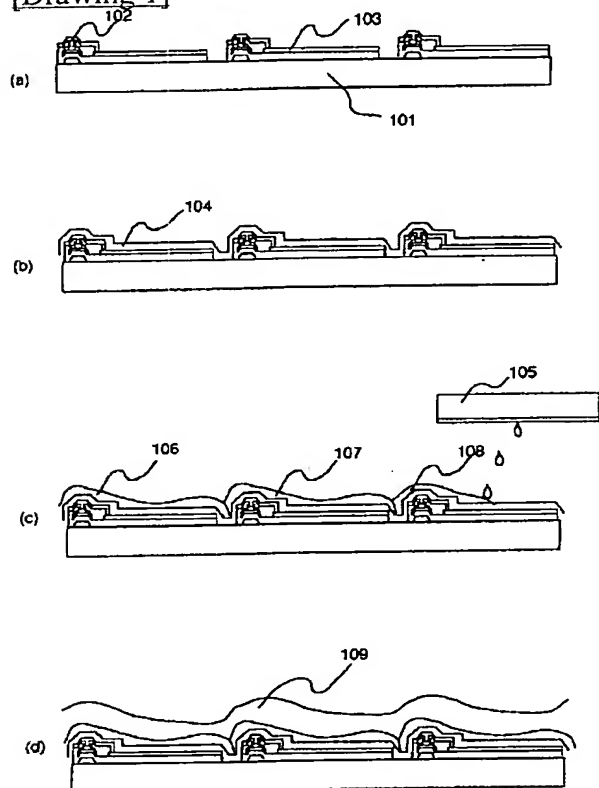
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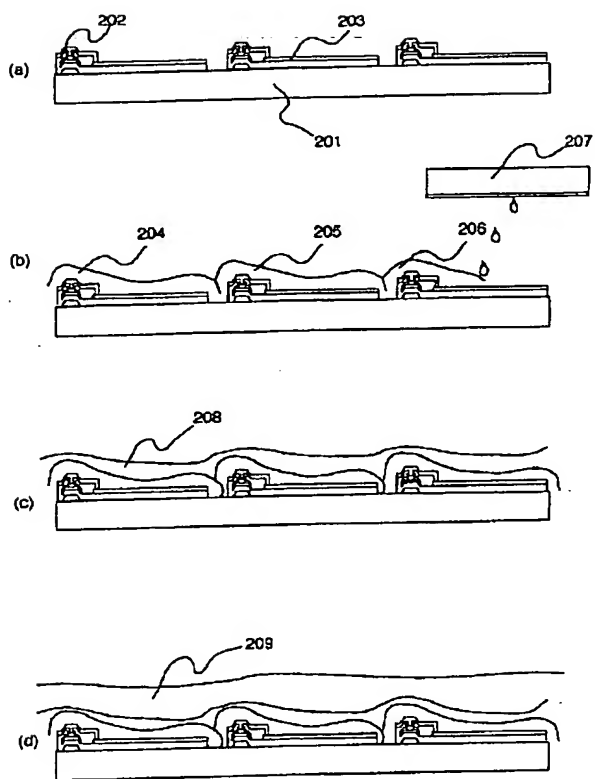
DRAWINGS

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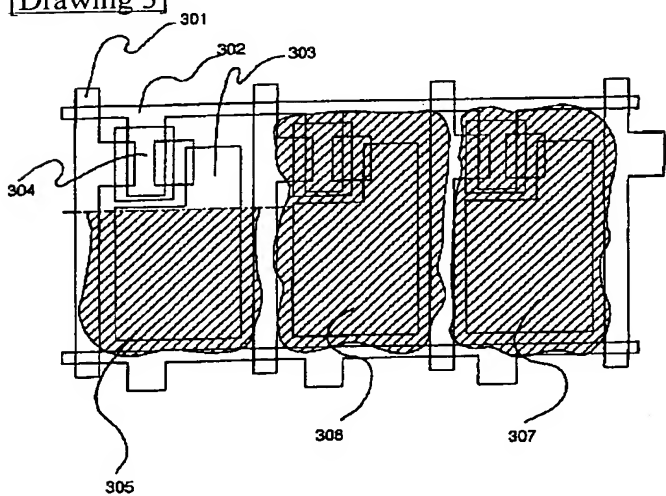
[Drawing 1]



[Drawing 2]



[Drawing 3]



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CORRECTION OR AMENDMENT

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[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law  
 [Category partition] The 1st partition of the 7th category  
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[Publication No.] JP,10-12377,A  
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[Procedure amendment]  
 [Filing Date] October 29, Heisei 11 (1999. 10.29)  
 [Procedure amendment 1]  
 [Document to be Amended] Description  
 [Item(s) to be Amended] Claim  
 [Method of Amendment] Modification  
 [Proposed Amendment]  
 [Claim(s)]

[Claim 1] A hole-injection layer is formed in the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor. In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color besides chosen as the layer from red, green, and blue for every pixel at least is formed, and a reflector is further formed in this upper layer The manufacture approach of the active-matrix mold organic electroluminescence display object characterized by making formation and the array of said organic luminous layer by the ink jet method.

[Claim 2] The manufacture approach of the active-matrix mold organic-electroluminescence display object characterized by to make formation and the array of said organic luminous layer by the ink-jet method in the manufacture approach of an active-matrix mold organic-electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a reflector is further formed in this upper layer.

[Claim 3] In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, a hole-injection layer is formed in this upper layer, and a transparent electrode is further formed in this upper layer The manufacture approach of the active-matrix mold organic electroluminescence display object characterized by making formation and the array of said organic luminous layer by the ink jet method.

[Claim 4] The manufacture approach of the active-matrix mold organic-electroluminescence display object characterized by to make formation and the array of said organic luminous layer by the ink-jet method in the manufacture approach of an active-matrix mold organic-electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a transparent electrode is further formed in this upper layer.

[Claim 5] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 4 which supplies a polymer or its precursor by said ink jet method, and forms said organic luminous layer.

[Claim 6] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 5 which forms said organic luminous layer which has the red luminescent color by cyano polyphenylene vinylene.

[Claim 7] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 6 which forms said organic luminous layer which has the green luminescent color by polyphenylene vinylene.

[Claim 8] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 7 which forms said organic luminous layer which has the blue luminescent color by polyphenylene vinylene and the poly alkyl phenylene.

[Claim 9] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 8 which constitutes said organic luminous layer from a poly alkyl fluorene.

[Procedure amendment 2]

[Document to be Amended] Description

[Item(s) to be Amended] 0009

[Method of Amendment] Modification

[Proposed Amendment]

[0009]

[Means for Solving the Problem] The manufacture approach of the active-matrix mold organic electroluminescence display object in connection with this invention A hole-injection layer is formed in the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor. The organic luminous layer (organic luminous layer which consisted of luminescent material which consists especially of a polymer or its precursor) which has the luminescent color besides chosen as the layer from red, green, and blue for every pixel at least is formed. Furthermore, in the manufacture approach of an active-matrix mold organic electroluminescence display object that a reflector is formed in this upper layer, it is characterized by making formation and the array of said organic luminous layer by the ink jet method. Moreover, in the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a reflector is further formed in this upper layer, it is characterized by making formation and the array of said organic luminous layer by the ink jet method.

----- [Procedure amendment]

[Filing Date] November 25, Heisei 11 (1999. 11.25)

[Procedure amendment 1]

[Document to be Amended] Description

[Item(s) to be Amended] Claim

[Method of Amendment] Modification

[Proposed Amendment]

[Claim(s)]

[Claim 1] A hole-injection layer is formed in the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor. In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color besides chosen as the layer from red, green, and blue for every pixel at least is formed, and a reflector is further formed in this upper layer The manufacture approach of the active-matrix mold organic electroluminescence display object characterized by forming said organic luminous layer with an ink jet method so that the configuration and array may serve as the last pattern.

[Claim 2] The manufacture approach of the active-matrix mold organic-electroluminescence display object characterized by to form said organic luminous layer with an ink-jet method in the manufacture approach of an active-matrix mold organic-electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a reflector is further formed in this upper layer so that that configuration and array may serve as the last pattern.

[Claim 3] In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, a hole-injection layer is formed in this upper layer, and a transparent electrode is further formed in this upper layer The manufacture approach of the active-matrix mold organic electroluminescence display object characterized by forming said organic luminous layer with an ink jet method so that the configuration and array may serve as the last pattern.

[Claim 4] The manufacture approach of the active-matrix mold organic-electroluminescence display object characterized by to form said organic luminous layer with an ink-jet method in the manufacture approach of an active-matrix mold organic-electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a transparent electrode is further formed in this upper layer so that that configuration and array may serve as the last pattern.

[Claim 5] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 4 which supplies a polymer or its precursor by said ink jet method, and forms said organic luminous layer.

[Claim 6] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 5 which forms said organic luminous layer which has the red luminescent color by cyano polyphenylene vinylene.

[Claim 7] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 6 which forms said organic luminous layer which has the green luminescent color by polyphenylene vinylene.

[Claim 8] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 7 which forms said organic luminous layer which has the blue luminescent color by polyphenylene vinylene and the poly alkyl phenylene.

[Claim 9] The manufacture approach of the active-matrix mold organic electroluminescence display object according to claim 1 to 8 which constitutes said organic luminous layer from a poly alkyl fluorene.

[Procedure amendment 2]

[Document to be Amended] Description

[Item(s) to be Amended] 0009

[Method of Amendment] Modification

[Proposed Amendment]

[0009]

[Means for Solving the Problem] The manufacture approach of the active-matrix mold organic electroluminescence display object in connection with this invention A hole-injection layer is formed in the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor. The organic luminous layer (organic luminous layer which consisted of luminescent material which consists especially of a polymer or its precursor) which has the luminescent color besides chosen as the layer from red, green, and blue for every pixel at least is formed. Furthermore, in the manufacture approach of an active-matrix mold organic electroluminescence display object that a reflector is formed in this upper layer, it is characterized by forming said organic luminous layer with an ink jet method so that that configuration and array may serve as the last pattern. Moreover, in the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from red, green, and blue as the transparence pixel electrode upper layer formed in the glass substrate which has a thin film transistor for every pixel at least is formed, and a reflector is further formed in this upper layer, it is characterized by form said organic luminous layer with an ink jet method so that that configuration and array may serve as the last pattern.

[Procedure amendment 3]

[Document to be Amended] Description

[Item(s) to be Amended] 0010

[Method of Amendment] Modification

[Proposed Amendment]

[0010] In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Furthermore, red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, a hole-injection layer is formed in this upper layer, and a transparent electrode is further formed in this upper layer It is characterized by forming said organic luminous layer with an ink jet method so that the configuration and array may serve as the last pattern. In the reflective pixel electrode upper layer formed in the glass substrate which has a thin film transistor, for every pixel at least Moreover, red, In the manufacture approach of an active-matrix mold organic electroluminescence display object that the organic luminous layer which has the luminescent color chosen from green and blue is formed, and a transparent electrode is further formed in this upper layer It is characterized by forming said organic luminous layer with an ink jet method so that the configuration and array may serve as the last pattern.

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(12) 公開特許公報 (A)

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特開平10-12377

(43) 公開日 平成10年(1998) 1月16日

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B 4 1 J 2/01			B 4 1 J 3/04	1 0 1 Z

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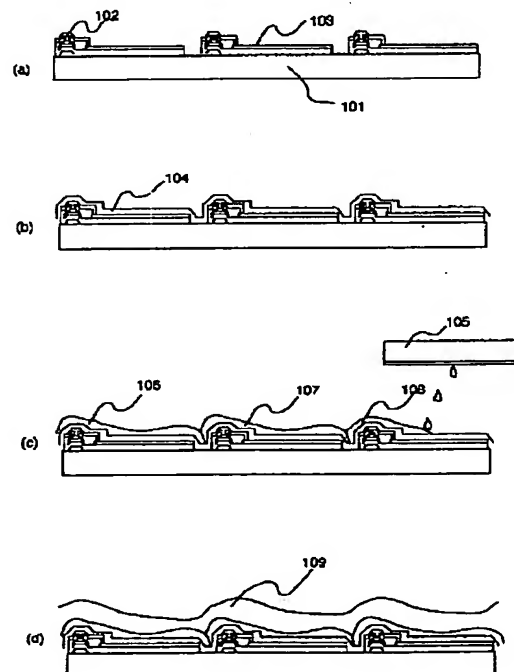
(21) 出願番号	特願平8-158671	(71) 出願人	000002369 セイコーエプソン株式会社 東京都新宿区西新宿2丁目4番1号
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		(74) 代理人	弁理士 鈴木 喜三郎 (外1名)

(54) 【発明の名称】 アクティブマトリックス型有機EL表示体の製造方法

(57) 【要約】

【解決手段】 従来、パターニングができないとされた有機EL材料をインクジェット方式により形成および配列することで、赤、緑、青の発光色を備える有機発光層を画素毎に任意にパターニングすることが可能となった。これにより、フルカラー表示のアクティブマトリックス型有機EL表示体を実現した。

【効果】 安価で大画面のフルカラー表示体が製造可能となり、効果は大である。



## 【特許請求の範囲】

【請求項1】 薄膜トランジスタを有するガラス基板に形成された透明画素電極上層に正孔注入層が形成され、この上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、更にこの上層に反射電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とするアクティブマトリックス型有機EL表示体の製造方法。

【請求項2】 薄膜トランジスタを有するガラス基板に形成された透明画素電極上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、更にこの上層に反射電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とするアクティブマトリックス型有機EL表示体の製造方法。

【請求項3】 薄膜トランジスタを有するガラス基板に形成された反射画素電極上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、この上層に正孔注入層が形成され、更にこの上層に透明電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とするアクティブマトリックス型有機EL表示体の製造方法。

【請求項4】 薄膜トランジスタを有するガラス基板に形成された反射画素電極上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、更にこの上層に透明電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とするアクティブマトリックス型有機EL表示体の製造方法。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、薄膜トランジスタを用いたアクティブマトリックス型のEL表示体のインクジェット方式を用いた製造方法に関する。

## 【0002】

【従来の技術】有機EL素子は、蛍光性有機化合物を含む薄膜を、陰極と陽極とで挟んだ構成を有し、前記薄膜に電子および正孔（ホール）を注入して再結合させることにより励起子（エキシトン）を生成させ、このエキシトンが失活する際の光の放出（蛍光・燐光）を利用して発光させる素子である。

【0003】この有機EL素子の特徴は、10V以下の低電圧で100～100000 cd/m<sup>2</sup> 程度の高輝度の面発光が可能であり、また蛍光物質の種類を選択するこ

とにより青色から赤色までの発光が可能なことである。

【0004】有機EL素子は、安価な大面積フルカラー表示素子を実現するものとして注目を集めている（電子情報通信学会技術報告、第89巻、NO. 106、49ページ、1989年）。報告によると、強い蛍光を発する有機色素を発光層に使用し、青、緑、赤色の明るい発光を得ている。これは、薄膜状で強い蛍光を発し、ピンホール欠陥の少ない有機色素を用いたことで、高輝度なフルカラー表示を実現できたと考えられている。

10 【0005】更に特開平5-78655号公報には、有機発光層の成分が有機電荷材料と有機発光材料の混合物からなる薄膜層を設け、濃度消光を防止して発光材料の選択幅を広げ、高輝度なフルカラー素子とする旨が提案されている。

【0006】しかし、いずれの報告にも、実際のフルカラー表示パネルの構成や製造方法については言及されていない。

## 【0007】

【発明が解決しようとする課題】前述の有機色素を用いた有機薄膜EL素子は、青、緑、赤の発光を示す。しかし、よく知られているように、フルカラー表示体を実現するためには、3原色を発光する有機発光層を画素毎に配置する必要がある。従来、有機発光層をパターンニングする技術は非常に困難とされていた。原因は、一つは反射電極材の金属表面が不安定であり、蒸着のパターンニング精度が出ないという点である。2つめは、正孔注入層および有機発光層を形成するポリマーや前駆体がフォトリソグラフィ等のパターンニング工程に対して耐性が無いという点である。

30 【0008】本発明は、上述したような課題を解決するものであり、その目的は、有機発光層をインクジェット方式により画素毎にパターンニングしたアクティブマトリックス型EL表示体の製造方法を提供することにある。

## 【0009】

【課題を解決するための手段】本発明に関わるアクティブマトリックス型有機EL表示体の製造方法は、薄膜トランジスタを有するガラス基板に形成された透明画素電極上層に正孔注入層が形成され、この上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、更にこの上層に反射電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とし、また、薄膜トランジスタを有するガラス基板に形成された透明画素電極上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、更にこの上層に反射電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とする。

【0010】更に、薄膜トランジスタを有するガラス基板に形成された反射画素電極上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、この上層に正孔注入層が形成され、更にこの上層に透明電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とし、また、薄膜トランジスタを有するガラス基板に形成された反射画素電極上層に少なくとも各画素毎に赤、緑、青より選択された発光色を有する有機発光層が形成され、更にこの上層に透明電極が形成されるアクティブマトリックス型有機EL表示体の製造方法において、前記有機発光層の形成および配列がインクジェット方式によりなされることを特徴とする。

【0011】本発明は、要するに図3に示すように、基板上に形成された信号線301、ゲート線302、画素電極303および薄膜トランジスタ304上に、インクジェット法により、赤、緑、青色の有機発光材料をパターンニング塗布することで、フルカラー表示を実現するものである。

【0012】

【発明の実施の形態】以下、本発明の好適な実施形態について図面を参照して説明する。

【0013】（実施例1）図1に示すように、ガラス基板101上に薄膜トランジスタ102を形成してから、ITO透明画素電極103を形成する。

【0014】正孔注入材料としてポリマー前駆体であるポリテトラヒドロチオフェニルフェニレンをコーティングする。加熱により、前駆体はポリフェニレンビニレンとなり、厚さ0.05ミクロンの正孔注入層104が形成される。

【0015】次に、インクジェットプリント装置105により赤、緑、青色を発色する発光材料をパターンニング塗布し、厚さ0.05ミクロンの発光層106、107、108を形成する。赤色発光材料にはシアノポリフェニレンビニレン、緑色発光材料にはポリフェニレンビニレン、青色発光材料にはポリフェニレンビニレンおよびポリアルキルフェニレンを使用する。これらの有機EL材料はケンブリッジ・ディスプレイ・テクノロジー社製であり、液状で入手可能である。

【0016】最後に、厚さ0.1~0.2ミクロンのMgAg反射電極109を蒸着法により形成する。

【0017】これにより、直視型のフルカラー有機EL表示体が完成する。

【0018】（実施例2）図2に示すように、ガラス基板201上に薄膜トランジスタ202を形成してから、AlLi反射画素電極203を形成する。

【0019】次に、インクジェットプリント装置207により赤、緑、青色を発色する発光材料をパターンニング塗布し、発光層204、205、206を形成する。赤

色発光材料にはシアノポリフェニレンビニレン、緑色発光材料にはポリフェニレンビニレン、青色発光材料にはポリフェニレンビニレンおよびポリアルキルフェニレンを使用する。これらの有機EL材料はケンブリッジ・ディスプレイ・テクノロジー社製であり、液状で入手可能である。

【0020】正孔注入材料としてポリマー前駆体であるポリテトラヒドロチオフェニルフェニレンをキャスト法により形成する。加熱により、前駆体はポリフェニレンビニレンとなり、正孔注入層208が形成される。

【0021】最後に、ITO透明電極209を蒸着法により形成する。

【0022】これにより、反射型のフルカラー有機EL表示体が完成する。

【0023】（実施例3）有機発光層の有機発光材料として2,3,6,7-テトラヒドロ-11-オキソ-1H,5H,11H-(1)ベンゾピラノ[6,7,8-i]j-キノリジン-10-カルボン酸を用い、有機正孔注入層材料として1,1-ビス-(4-N,N-ジトリルアミノフェニル)シクロヘキサンを用い、両者を混合することで緑色の発光材料とする。

【0024】同様に、赤色の有機発光材料として、2-1,3',4'-ジヒドロキシフェニル)-3,5,7-トリヒドロキシ-1-ベンゾピリリウムパークロレートを用いて正孔注入層材料と混合する。

【0025】更に、青色発光層には有機正孔注入材料としてトリス(8-ヒドロキシキノリノール)アルミニウムを用い、有機発光材料として、2,3,6,7-テトラヒドロ-9-メチル-11-オキソ-1H,5H,11H-(1)ベンゾピラノ[6,7,8-i]j-キノリジンを混合し、発光材料を作成する。

【0026】実施例1または実施例2と同様な工程で、各々の発光層をインクジェットプリンタ装置により局所パターンニングし、アクティブマトリックス型有機EL表示体を作成する。

【0027】なお、本実施例で使用した有機EL材料以外にも、アロマティックジアミン誘導体(TDP)、オキシジアゾールダイマー(OXD)、オキシジアゾール誘導体(PBD)、ジスチルアリーレン誘導体(DSA)、キノリノール系金属錯体、ベリリウム-ベンゾキノリノール錯体(Be bq)、トリフェニルアミン誘導体(MTDATA)、ジスチル誘導体、ピラゾリンダイマー、ルブレン、キナクリドン、トリアゾール誘導体、ポリフェニレン、ポリアルキルフルオレン、ポリアルキルチオフェン、アゾメチン亜鉛錯体、ポリフィリン亜鉛錯体、ベンゾオキサゾール亜鉛錯体、フェナントロリンユウロピウム錯体を使用できるが、これに限られる物ではない。

【0028】

【発明の効果】従来、パターンニングができなかった有機EL材料をインクジェット方式により形成および配列することでパターンニングが可能となり、フルカラー表

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示のアクティブマトリクス型有機EL表示体を実現した。これにより、安価で大画面のフルカラー表示体が製造可能となり、効果は大である。

【図面の簡単な説明】

【図1】本発明の第1の実施形態におけるアクティブマトリクス型有機EL表示体の工程を示す図である。

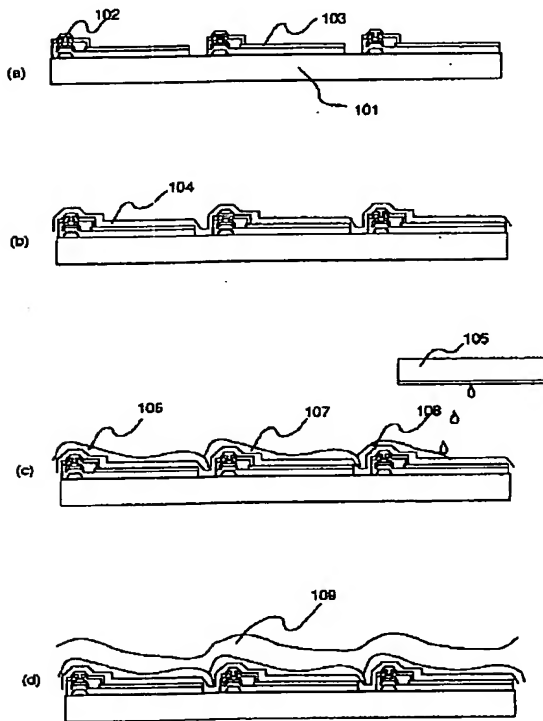
【図2】本発明の第2の実施形態におけるアクティブマトリクス型有機EL表示体の工程を示す図である。

【図3】本発明の薄膜トランジスタ上にインクジェット法により形成された発色層を示す図である。

【符号の説明】

- 101 ガラス基板
- 102 薄膜トランジスタ
- 103 透明画素電極
- 104 正孔注入層
- 105 インクジェットプリンタヘッド
- 106 有機発光層（第1色）
- 107 有機発光層（第2色）

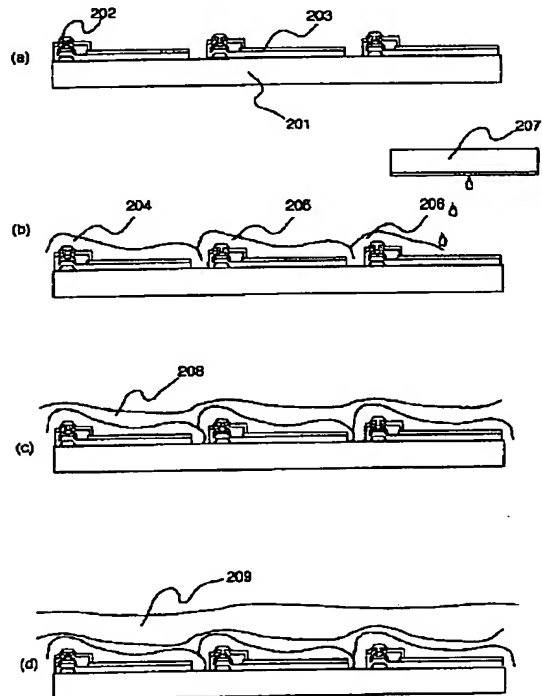
【図1】



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- 108 有機発光層（第3色）
- 109 反射電極
- 201 ガラス基板
- 202 薄膜トランジスタ
- 203 反射画素電極
- 204 有機発光層（第1色）
- 205 有機発光層（第2色）
- 206 有機発光層（第3色）
- 207 インクジェットプリンタヘッド
- 208 正孔注入層
- 209 透明電極
- 301 信号線
- 302 ゲート線
- 303 画素電極
- 304 薄膜トランジスタ
- 305 有機発光層（第1色）
- 306 有機発光層（第2色）
- 307 有機発光層（第3色）

【図2】



(5)

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【図 3】

